MAGNETIC SOUND DEADENING WALL TREATMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The invention relates to the use of magnetizable and magnetic sound deadening materials for wall covering to simultaneously reduce wall vibration and reflected "nuisance noise". The sound deadening magnetic materials employed for wall treatment utilizes a magnetic layer to hold the sound deadening or sound attenuating material to a wall, such as steel (which may be disposed behind concrete), as is typically found in office buildings, factories, machinery and appliances.

2. Brief Description of the Prior Art:

In the past, sound absorbing and vibration dampening materials have been applied with adhesives and tapes. In the case of vibration dampening materials, the materials are often rolled or sprayed onto a surface to maximize contact with the surface and thereby achieve the best vibration dampening effects. Sound absorbing materials were applied in a manner similar to the vibration dampening materials.

Magnetizable insulating members have been known for use as "sound-deadening films" in automobile technology to prevent drumming of the metal sheet parts, particularly body parts

covered therewith, and have also been used for deadening body noise.

U.S. Patent 4,010,818 disclose magnetizable insulating members in which barium ferrite is disposed as magnetizable particles in bitumen in the insulating or deadening insulating layer, which fulfills the purpose of "sound-deadening". So that the sound-deadening films can be easily and permanently attached in the auto body parts, the underside of the insulating layer having the magnetizable particles is provided with an adhesive layer, which has a hot melt, i.e. a compound becoming adhesive upon the application of heat, or a pressure-sensitive adhesive, i.e. a self-adhesive. Magnetic strip compound layers with non-magnetic films is such that the proportion of magnetizable particles, i.e. barium ferrite, on the flat insulating member is more than 50% by weight, so that the acoustic properties of sound insulating or sound deadening by the bitumen layer are impaired. This disadvantage had been tolerated, as the magnetic efficiency improves the attachment to curved or corrugated under surfaces, i.e. in the floor area of automobile doors, in comparison to such sound-deadening films or sound-deadening matting, which have a self-adhesive layer on the insulating or deadening layer, without using magnetic particles. However, even the latest developments in bituminous magnetic films, which are provided with a pressure

sensitive adhesive layer, do not improve the previously known systems to any significant degree.

A constrained layer damper having slits and/or cutout(s) that provides improved vibration dampening is disclosed in U.S. Patent 5,725,931. The constrained layer comprises, generally:

a damper comprising:

a construction comprising:

a layer(s) of vibration damping material attached to one side of a backing wherein the backing has a Young's Modulus greater than that of the layer(s) of vibration damping material;

wherein the construction has a hole passing through the center of the construction;

wherein the construction has a perimeter and the hole has a perimeter;

wherein the construction has at least one slit, each slit independently extending through the backing and optionally further extending through the vibration damping material layer(s), wherein the damper has improved vibration damping properties compared to an identical damper not having slit(s).

U.S. Patent 4,346,782 disclose a method of producing a structure-borne vibration and sound damping and at the same time corrosion and abrasion resistant coating on a rigid substrate in which successively, two coating materials with different moduli of elasticity are applied to the substrate.

This method is improved in that a first coating of a viscoelastic material is sprayed onto the substrate having after gelling and/or curing a modulus of elasticity of 5 X 10^6 to 5 x 10^8 dynes/cm^2 and in that onto the first coating there is sprayed a second coating of a viscoelastic material which after gelling and/or curing has a modulus of elasticity of 5 X 10^7 to 5 x 10^9 dynes/cm^2, the modulus of elasticity of the second outer coating being at least 10 times greater than that of the first coating.

There is a need to provide an acoustic absorption material that simultaneously reduces wall vibration and "nuisance noise", whereupon the magnetizable or magnetic layer may be applied non-adhesively as a treatment to a wall, such as a steel wall (as is typically found in office buildings, factories, machinery and appliances) together with an attached sound attenuating layer.

SUMMARY OF THE INVENTION

One object of the present invention is to provide a wall covering that simultaneously reduces wall vibration and reflected "nuisance noise".

Another object of the present invention is to provide a wall covering that simultaneously reduces wall vibration and reflected "nuisance noise" that utilizes a magnetizable or

magnetic viscoelastic layer to non-adhesively hold together with an acoustic absorption or sound attenuating layer, the sound deadening material to a steel wall or steel structure.

A further object of the present invention is to provide a wall covering that simultaneously reduces wall vibration and reflected "nuisance noise" that utilizes a magnetizable or magnetic viscoelastic layer and a constrained layer(s) and an acoustic absorption or sound attenuating layer to non-adhesively hold the sound deadening material to a steel wall, so as to dissipate vibrational stress energy as shear deformation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial section view of a magnetizable or magnetic viscoelastic constrained layer with an attached rigid constraining layer.

FIG. 2 is a partial section view of a magnetizable or magnetic viscoelastic constrained layer having a rigid constraining layer attached thereto, and an acoustic absorption or sound attenuating layer attached to the rigid constraining layer, that serves as a sound deadening wall treatment.

FIG. 3 is a schematic cross-section through the magnetic sound deadening wall treatment showing a magnetic viscoelastic constrained layer having a second constrained layer (11) and a

rigid constraining layer (11') thereon, and an acoustic absorption or sound attenuating layer attached to the top rigid constraining layer.

The foregoing and other objects of the present invention will be better understood by reference to the detailed description of the preferred embodiments of the invention hereafter set forth.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Damping materials in the form of layers may be referred to as extensional and constrained layers.

Extensional damping uses a layer of a visco-elastic material bonded to a substrate. Vibrational energy is dissipated from the extension and compression of the material under vibrational stress from the substrate. The energy is dissipated in the form of low-grade molecular heat.

Constrained-layer damping uses a vibration dampening constrained-layer consisting of a visco-elastic material bonded to a rigid constraining layer. When the system flexes during vibrational distortion, sheer forces are created on the rigid constrained layer, and energy is dissipated through sheer deformation (tensional forces).

The rigid constraining layer used in conjunction with the constrained layer is aluminum foil of from about 7 to about 10

mil - however, steel, wood or any rigid substance would suffice. The rigid constraining layer prevents the constrained layer from moving.

The absorption coefficient of the layer or layers used in the acoustic absorption material and/or the sound attenuating layer is a number proportional to the ratio of the amplitude of the sound waves impacting a surface.

The ASTM Standard Test method for determining sound absorption and sound absorption coefficients are known by skilled persons in the art by resort to the standard ASTM test C423-02a and is incorporated herein by reference in its entirety. The ASTM Standard Test method for determining the interzone attenuation of sound reflected by wall finishes is E1376-90(2002) and is incorporated herein by reference in its entirety.

In the context of the invention, the magnetizable or magnetic viscoelastic constrained layer 10 may be attached to a rigid constraining layer 11, as shown in FIG. 1.

The constrained layer is a matrix containing magnetizable or magnetic particles dispersed therein and may be an acrylic polymer based plastisol. Typically, the polymer is a mixture of elastomers and thermoplastic elastomers, i.e. polyethylene, chlorinated polyethylene, polyisobutylene and SBR. Preferrably, the constrained layer is filled bitumen, a vinyl material such as a methylmethacrylate/butyl methacrylate

copolymer, which may be admixed with an aryl alkyl sulfonate, rubber, neoprene or spray-on viscoelastic materials.

Alternatively, as can be seen from FIG. 2, the magnetic sound deadening wall treatment material of the invention may comprise a magnetizable or magnetic viscoelastic constrained layer, a rigid viscoelastic constraining intermediate layer 11 and an acoustic absorption or sound attenuating layer 12 attached to the rigid viscoelastic damping constrained intermediate layer 11. The sound absorption material 12 is a vibration dampening layer that has been laminated or applied as an adhesive or coating by well known prior art techniques.

Acoustic absorption or sound attenuating layers are well known in the art, and may typically comprise a nonwoven material or a foam material.

As may be seen from FIG. 3, the magnetic sound deadening wall treatment material of the invention may, alternatively, also comprise a magnetic viscoelastic constrained layer 10 attached a rigid constrained viscoelastic damping layer 11 and a constrained layer 11'. As indicated in connection with FIG. 2, the acoustic absorption or sound attenuating layer 12 may comprise a known noise absorbing material capable of substantially reducing any sound reflections.

The magnetic viscoelastic layer may be a matrix comprised of any well known magnetic or magnetizable particles inclusive of barium ferrite, strontium ferrite, and an alloy magnetic

substance employing Fe, Co, or Ni, or an alloy magnetic substance inclusive of but not limited to: AlNiCo, FeCrCo, NdFeB and SmCo. Typically, the size of these particles are about 2 microns and will constitute from about 70 to about 90% by weight of the matrix. The magnetic layer 10 adheres to the steel wall by magnetic attraction.

Although not critical, it is preferred that the thickness of the acoustic absorption layer can range from about 0.25 inches to about 3 inches. The thickness of the rigid layers may range from about 3 to about 10 mils, most preferably, from about 7 to about 10 mils. The thickness of the constrained viscoelastic dampening layer can range from about 0.5 to about 60 mils; preferably about 1 to about 10 mils, and most preferably from about 2 to about 5 mils. In the context of the invention, it is preferred that the thickness of the magnetizable or magnetic viscoelastic constrained layer range from about 6 mils to about 120 mils. Preferrably, from 12 to 30 mil.

While the invention has been described by reference to specific embodiments, it is to be understood that many variations may be made without departing from the spirit and scope of the invention, which is limited only by the appended claims.